Northwest Fisheries Science Center

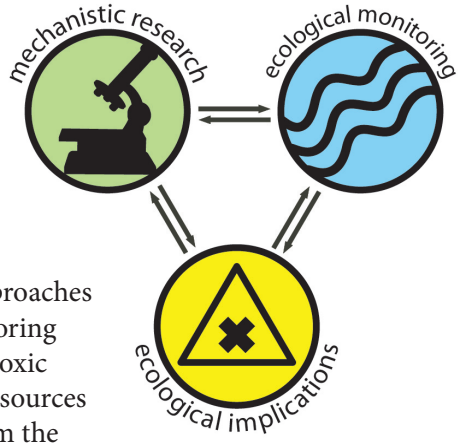
Environmental Toxicology and Chemistry Research

Environmental Conservation Division

2011

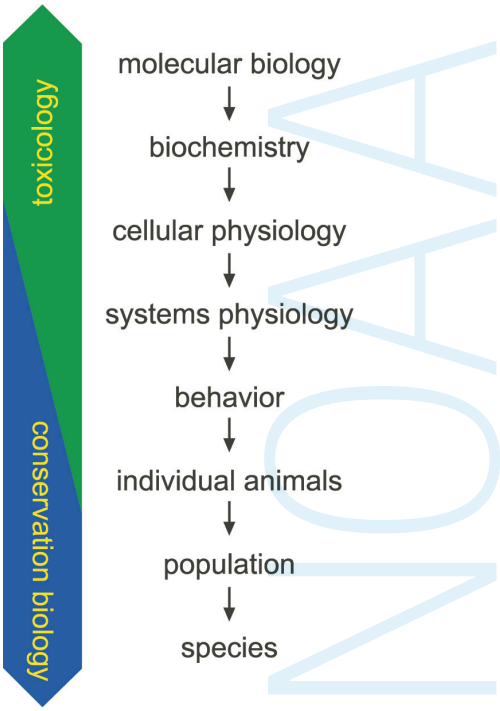
NOAA FISHERIES SERVICE

Understanding the impacts of chemicals: An integrated approach



Environmental toxicology and chemistry is an integral part of the NWFSC's research mission. Our goal is to understand the impacts of anthropogenic (e.g., chemical contaminants) and natural perturbations on fishery resources, protected species, and habitat quality, and our results are used regionally and nationally to determine scientifically-sound approaches for conserving living marine resources and restoring habitat function. We also assess the impacts of toxic substances on the health and safety of fishery resources and respond to environmental emergencies from the release of toxic materials.

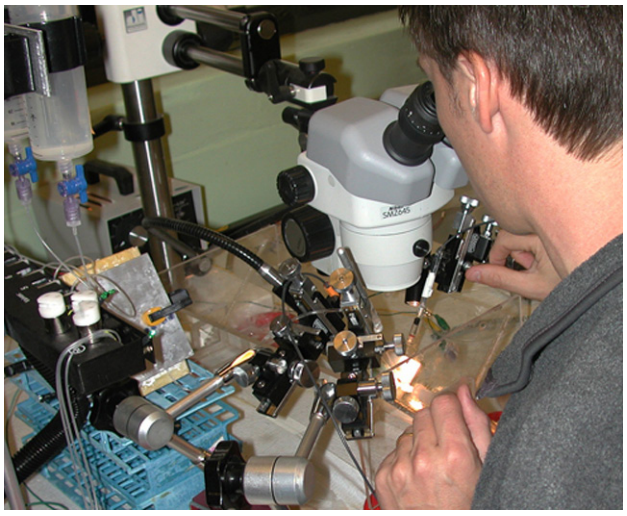
By using an interdisciplinary and integrated approach across three interconnected research areas, we have the capability to determine the influence of chemicals in the environment across multiple scales of biological organization.



A fundamental challenge in applying environmental toxicology and chemistry to environmental conservation is linking the impacts of chemicals across a range of biological scales.

Mechanistic Research

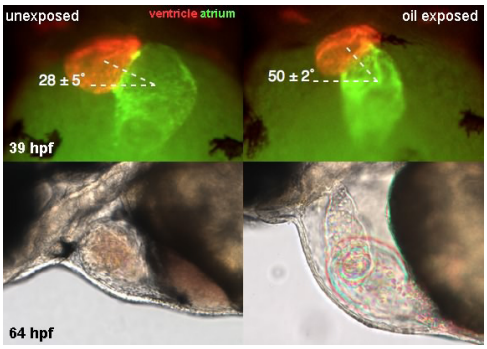
Our mechanistic research focuses on controlled experiments designed to study specific mechanisms of toxicity and how they affect the biology of a variety of species of concern (e.g., salmon and their invertebrate prey). We rely on techniques that include molecular biology, enzyme biochemistry, immunocytochemistry, pathology, neurobiology, and behavior.



Scientists acquiring the electrical recordings from the nose of juvenile salmon.

Recent studies include:

- Effects of polycyclic aromatic hydrocarbons on the cardiac development of embryonic fish.
- Synergistic effects of mixtures of organophosphate pesticides on the neurochemistry and behavior of juvenile fish.
- Effects of dissolved copper on the olfactory physiology and behavior of juvenile salmon.
- Effects of urban stormwater on aquatic invertebrate behavior and survival.



Effects of oiled gravel effluent on the developing fish heart.

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Science, Service, Stewardship

Beach seining for juvenile salmon.

Trawling for bottom fish.

Salmon exposure tanks at the Mukilteo Research Station.

For more information:

- **Website |** http://www.nwfsc.noaa.gov/research/divisions/ec/index.cfm
- **Toxicology | Nat Scholz** nathaniel.scholz@noaa.gov
- **Chemistry | Gina Ylitalo** gina.ylitalo@noaa.gov

Ecological Monitoring

Ecological monitoring involves field studies combined with analytical chemistry and other analyses to monitor the health and survival of species of concern and the quality of their habitat (e.g., contaminant exposure and prey abundance). For instance, by monitoring the abundance and diversity of fish and their prey (e.g. aquatic invertebrates) and analyses of water, tissue, and sediment collected in the field, we significantly improve our understanding of where animals are being exposed to chemicals of concern and how they are being affected by the exposure.

Recent studies include:

Female coho salmon that died before spawning.

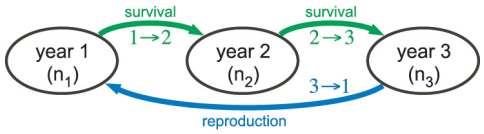
- Monitoring urban streams to determine the extent and cause of pre-spawn mortality in adult coho salmon.
- Monitoring invertebrate prey availability and salmon feeding in urban and agricultural watersheds.
- Assessing the effects of the *Cosco Busan* oil spill on herring development.
- Assessing the contaminant exposure in outmigrating juvenile salmon and their habitats in the lower Columbia River.
- Assessing improvements in English sole health as a result of remediation of contaminated sites in Puget Sound.
- Monitoring persistent organic pollutants in marine species of concern.
- Monitoring seafood safety in the Gulf of Mexico following the Deepwater Horizon oil spill.

Ecological Implications

This research area focuses on the implications of our research, and others, to the biology and ecology of species of concern. An example is quantitatively describing the relationships between anthropogenic disturbances (e.g., exposure to chemical contaminants) that affect habitat quality and organismal and population responses. Our research uses a combination of experimental studies, data analyses, and computer modeling to help identify thresholds for pollutant effects that may indicate or lead to population level impacts.

Recent studies include:

- Developing demographic life-history models for salmon and English sole to assess how sublethal effects on individual behavior, growth, and fecundity can produce population-level effects.
- Developing methods for analyzing toxicant responses based on critical body residues.
- Using chemical tracers to develop models to estimate ages and feeding ecology of cetaceans.
- Incorporating the indirect impact of pesticides on juvenile salmon due to a reduction in invertebrate prey into life-history models.



$$A = \begin{bmatrix} 0 & 0 & 3\to1 \\ 1\to2 & 0 & 0 \\ 0 & 2\to3 & 0 \end{bmatrix} \quad \vec{n}(t) = \begin{bmatrix} n_1 \\ n_2 \\ n_3 \end{bmatrix}$$

$$\vec{n}(t+1) = A\vec{n}(t)$$

Coho salmon life-history (females return after 3 years)
Projection Matrix (describes the transition between ages)
Abundance Vector (describes the population size)
Projection Equation (computes the following year).